Luminescent radical based organic nanoparticles for biomedical applications

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Trityl-based radicals are a unique class of organic molecules featuring a propeller-like structure that stabilizes their unpaired electron, endowing them with exceptional thermal and chemical stability. These radicals exhibit remarkable properties such as magnetic spin, chirality, and strong optical activity, making them highly promising for multifunctional applications in bioimaging and luminescent devices.

Among them, tris-(2,4,6-trichlorophenyl)methyl radicals (TTM$^{\bullet}$) have been dispersed in their hydrogenated precursors (TTM-αH) to formulate organic radical nanoparticles (TTM-ONPs) via reprecipitation, resulting in fluorescent ratiometric nanothermometers. These nanosystems have proven reliable temperature sensing across a wide range of pH, concentrations, ionic strengths and even *in vivo* conditions with sensitivities of up to 3.7%·K^{-1} in the biological temperature range.

Furthermore, atropisomers of trityl radicals have recently emerged as efficient emitters of circularly polarized light (CPL), which is gaining more interest in the bioimaging field, thanks to its low scattering cross section, low depolarization and the possibility to be easily isolated from the background noise. We successfully used TTBrM$^{\bullet}$, a brominated analog of TTM$^{\bullet}$, which exhibits higher racemization barrier and red-shifted emission, to obtain nanoparticles with CPL emission in biological conditions. Our current work aims to develop a first CPL-based ratiometric nanothermometer in aqueous media. These efforts pave the way for new strategies in CPL-based biosensing and multifunctional nanothermometry.

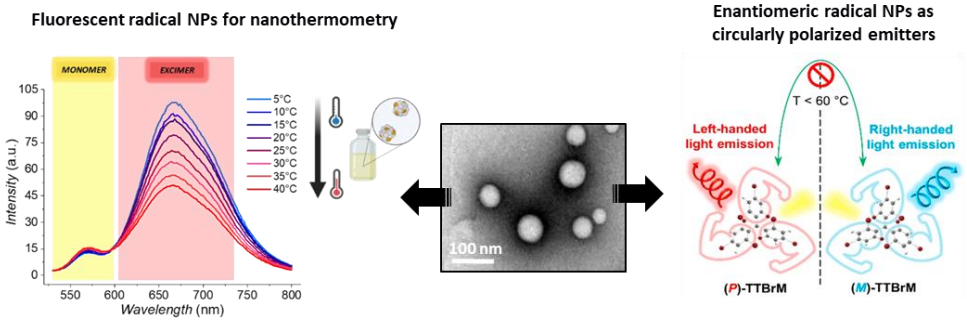

Fig. 1: *Left) Temperature-dependent fluorescence emission spectra of TTM radical doped ONPs in water; Right) Efficient circularly polarized luminescent magnetic emitters from enantiopure propeller-like trityl-brominated radicals with high racemization barrier.*

References

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